In the Figures:

New figures are enclosed. FIGURES 1 through 8 have been modified to clarify the description of the invention as directed by the Examiner. Applicant submits that no new matter has been introduced by way of such clarification.

REMARKS

This Amendment responds to an Office Action mailed December 18, 2002, with respect to the above-identified application. Claims 1 through 20 are pending in the application. The Office Action objected to the drawings and the specification. Further, Claims 14-20 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Also, Claims 1-4, 7, 14, and 17-20 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,413,048 to Muylaert ("Muylaert"). In addition, Claims 8 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Muylaert. Lastly, Claims 5, 6, 9-13, and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Muylaert in view of U.S. Patent No. 4,859,148 to Hibyan ("Hibyan"). The Office Action was not made final. Applicant has clarified the figures and accompanying textual description, and made corrections to the specification. Based on the following response, Applicant respectfully requests reconsideration and allowance of Claims 1-20.

Rejections Under § 112

Claims 14-20 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. The Examiner suggested in the Office Action that Claim 14, line 7, should have included language indicating that the recitations following the phrase "a plurality of

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816 Second Avenue
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bearing elements" should have been specified as to refer to clarify to what those recitations pertained. The Examiner is entirely correct. Claim 14, line 7, has been amended to state "a plurality of bearing assemblies, each bearing assembly including . . ." (underline added to highlight addition) to clarify the Claim. Claims 15-20 depend from Claim 14, and Applicant submits that the amendment to Claim 14 also addresses the Examiner's concerns with the dependent claims. With the amendment to Claim 14, Applicant respectfully requests that the Examiner reconsider Claims 14-20 and find that they are allowable under 35 U.S.C. § 112.

Rejections Under § 102(e)

Claims 1-4, 7, 14, and 17-20 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,413,048 to Muylaert. The Office Action stated that Muylaert anticipates the Claims listed by disclosing the following elements:

> "a rotary aircraft fully articulated hub assembly comprising a hub center body (12) including a plurality of attachment sections (14) configured to receive a plurality of bearing assemblies, positioned about a periphery of the hub center body, a plurality of rotor assemblies (16) configured to receive a pair of bearing assemblies (20a, 20b) and a plurality of bearing assemblies each assembly including an outer housing having an outer surface and an inner surface, the outer surface (28a, 28b) configured to mechanically connect the bearing assembly to the attachment sections of the hub center body, the inner surface being configured to receive a pair of taper conical elastomeric bearing elements, each bearing element having an inner race and an outer race (42, 46), an axial pre-load being applied through the inboard bearing element and the outboard bearing element, the respective inner race bearing elements being configured to receive a portion of the rotor assemblies. (Column 3, lines 50-52)"

(Emphasis added.) Applicant respectfully traverses,

Muylaert describes a rotor hub assembly having bearing elements each of which use a single elastomeric bearing. More specifically, as shown in FIGURES 2 and 3 of Muylaert, two bearing assemblies 20a and 20b are used to couple rotors to the hub assembly. However, each of the bearing assemblies 20a and 20b uses only a single elastomeric bearing element:

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> FIGS. 4 and 5 show detailed views of the elastomeric bearing 20a. Although only bearing 20a is illustrated, it is to be understood that the bearing 20b is a mirror image thereof. The bearing sleeve 26 is defined by an inner race 42. The dowel pins 40 are rigidly secured to the inner race 42. An elastomeric element 44, multilayered in the preferred embodiment, is circumferentially disposed outboard of the inner race 42. An outer race 46 is circumferentially disposed outboard of the elastomeric element 44 and forms the outer portion of the body 24. The inner race 42 and outer race 46 move relative to one another by the compression or expansion of the elastomeric element 44. This allows the rotor arm assembly 16 (FIG. 1), interconnected to the bearing 20 via the tie bar housing 22 (FIG. 2) and dowel pins 40, to flap in a vertical direction when the forces on the helicopter blades are uneven.

Muylaert, column 3, lines 17-33 (emphasis added). Moreover, FIGURE 4 which presents a detailed view of the bearing assembly 20a shows only a single reference numeral 44 referencing a single elastomeric bearing element 44. The description from Muylaert makes clear that each of the bearing assemblies 20a and 20b incorporates only a single elastomeric element.

Although bearing assemblies 20a and 20b according to Muylaert only incorporate a single elastomeric bearing element, terms used in the description of Muylaert do obscure that issue to some extent. It is clear from FIGURES 4 and 5 and the accompanying text referenced above that parts 20a and 20b according to Muylaert are bearing assemblies, each having a bearing sleeve 26, a body 24, an elastomeric element 44, and other elements. Nonetheless, Muylaert refers to these assemblies collectively as "elastomeric bearings." Column 3, lines 17-18. Thus, because a pair of bearing assemblies 20a and 20b is used to couple each rotor to the hub, one on a leading edge of the rotor and one on the lagging edge of the rotor (column 3, lines 10-13 and FIGURE 3), in Muylaert's parlance a pair of elastomeric bearings is used to couple each rotor to the rotor hub. Notwithstanding, each of Muylaert's "bearings" or bearing assemblies only includes a single elastomeric element 44.

According to Claim 1, each bearing assembly according to Applicant's invention comprises an outer housing having a first section and a second section, in which a tapered conical inboard bearing element is disposed within the first section with a taper of the inboard bearing being inwardly directed. The bearing assembly also comprises a tapered conical

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outboard bearing element disposed within the second section, with a taper of the outboard bearing being inwardly directed in a direction that is substantially directly opposed to the inboard bearing taper. Using these elements, an axial pre-load is applied through the opposed inboard bearing element and the outboard bearing element. In sum, each bearing assembly includes at least two bearing elements, an inboard element and an outboard element. Respectfully, Muylaert neither teaches nor suggests using inboard and outboard bearing elements as recited by Claim 1.

Because Muylaert, does not teach or suggest all the limitations recited in Claim 1, Applicant respectfully requests the Examiner reconsider Claim 1 and find it is patentable over the applied reference. Similarly, because Claims 2-4 and Claim 7 depend from patentable Claim 1, Applicant respectfully requests the Examiner also find that Claims 2-4 and Claim 7 are patentable over the applied reference.

Similarly, Claim 14 also recites a multiple-elastomeric bearing element structure not disclosed by Muylaert, wherein the bearing assembly includes an "inner surface being configured to receive a pair of taper conical elastomeric bearing elements, each bearing element having an inner race and an outer race, an axial pre-load being applied through the inboard bearing element and the outboard bearing element, the respective inner race bearing elements being configured to receive a portion of the rotor assemblies" (emphasis added). Again, because the applied reference does not teach or suggest using "a plurality of bearing assemblies," Applicant respectfully requests the Examiner reconsider Claim 14 and find it patentable over the applied reference. Similarly, because Claims 17-20 depend from patentable Claim 14, Applicant respectfully requests the Examiner also find that Claims 17-20 are patentable over the applied reference.

In sum, Applicant asks the Examiner to find that Claims 1-4, 7, 14, and 17-20 are novel and patentable over the applied reference.

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816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301

Rejections Under § 103(a)

Claims 8 and 15 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Muylaert, and Claims 5, 6, 9-13, and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Muylaert in view of Hibyan. Applicant respectfully submits that a *prima facie* case of obviousness has not been set forth.

In light of the foregoing discussion, Applicant submits that Claims 5, 6, 8-13, 15, and 16 all depend from patentable claims. More specifically, as discussed above, Muylaert discloses bearing assemblies incorporating only a single bearing element. Thus, Muylaert neither teaches nor suggests the claimed invention, and a *prima facie* case of obviousness has not been set forth.

Moreover, because Claims 5, 6, 8-13, 15, and 16 add further limitations to patentable claims, Applicant requests that the Examiner reconsider the rejection and find these claims patentable over the applied references.

CONCLUSION

In view of the above amendments and remarks, Applicant very respectfully submits that Claims 14-20 are sufficiently definite under 35 U.S.C. § 112, second paragraph. Also, Claims 1-4, 7, 14, and 17-20 are patentable over Muylaert ("Muylaert"). In addition, Claims 8 and 15 are patentable over Muylaert. Lastly, Claims 5, 6, 9-13, and 16 are patentable over Muylaert in view of Hibyan ("Hibyan"). Further, Applicant has amended the specification and the drawings to overcome the objections set forth in the Office Action without adding any new matter.

Applicant very respectfully submits that all claims pending in this application are patentable over the cited references and are in condition for allowance. Applicant very respectfully requests entry of the Amendment, and reconsideration and allowance of all claims.

BLACK LOWE & GRAHAM PLLC
816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301

Respectfully submitted,

BLACK LOWE & GRAHAM PLLC

Frank J. Bozzo
Registration No. 36,756
Direct Dial: 206.957.2483.

BLACK LOWE & GRAHAM PLLC
816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

At page 2, line 4, please replace the current paragraph with this paragraph:

"Elastomeric conical bearings are commonly used in bearing assemblies for helicopter rotor systems to accommodate rotor motion. The bearing assemblies are axially preloaded to prevent the conical bearing elements from experiencing a resultant tensional load. Currently, mono-directional bearing elements are employed at each attachment site of the main rotor hub. FIGURE 1 depicts a view of a prior art articulated hub assembly 20a. The hub assembly 20a includes a ~~tire~~ tie bar 26 connected to a hub center body 22. ~~The tie bar 26 is connected to the center body 22 in a similar manner as disclosed in FIG.1, however, the~~Each bearing assembly 30a ~~is substantially different. The bearing assembly 30~~ includes a ~~pair of~~ conical bearing elements 52 contacting the journal 28 on the bearing's inner surface 52 and the outer bearing surface is contained within an outer housing 42a. Each bearing ~~element is~~assembly also includes a mono-directional single conical taper ~~bearing having an~~ elastomeric bearing element 54 contained within. The conical ~~bearings~~bearing elements 52 are arranged such that the apex of the conical bearing elements 52 extends radially outward from one another. The bearing arrangement yields a force couple that extends from one bearing to the other. The force couple yields a bearing pre-load path 43 extending through the hub center body 22."

At page 3, line 20, please replace the current paragraph with this paragraph:

"FIGURE 2 depicts a fully articulated hub assembly ~~20~~ 20b that includes a pre-loaded, opposed ~~flap~~ bearing assembly ~~30~~ 30b that maintains a force couple bearing pre-load path entirely within the ~~flat~~ bearing assembly 30~~.~~b. The hub assembly ~~20~~ 20b includes a plurality of rotor assemblies 24 radially attached to a hub center body 22. The articulated hub assembly ~~20~~20b is designed to allow and to control the flap, pitch and lead-lag motion of an aircraft rotor."

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816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301

At page 3, line 26, please replace the current paragraph with this paragraph:

"In a presently preferred embodiment, the rotor assembly 24 includes a tie bar 26. However, any other rotor attachment structure or assembly is considered within the scope of the invention. The tie bar 26 is a substantially cylindrical shaped element having a pair of radially opposed journals 28 at an end. Each journal 28 is designed to receive the ~~flap~~ bearing assembly 30~~.~~b. The bearing assembly 30 extends over the journal 28 attaching itself to the journal 28. The tie bar 26 and bearing assembly ~~30~~30b combination attach the rotor assembly 24 to the hub center body 22."

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At page 3, line 33, please replace the current paragraph with this paragraph:

"The ~~flap~~ bearing assembly ~~30~~30b includes an inboard bearing element 32 and an outboard bearing element 34 contained within an outer housing ~~42 to form the bearing assembly 30. The~~ 42b. An outer surface of the outer housing ~~42~~42b is configured to attach the bearing assembly 30b to another structure, for example, the main rotor ~~hub~~hub 22. In a presently preferred embodiment, the outer housing ~~42~~ 42b includes two pair of radially extending bearing flanges 36 configured to mate with a hub yolk 38 of the hub center body 22. However, any other structure or arrangement for attaching the bearing assembly to the rotor hub located on the outer housing ~~42~~42b is considered within the scope of this invention~~, for example~~, including, to provide a pair of non-limiting examples, an outer housing having a single pair of flange projections or ~~molding the~~an outer housing molded to fit a shape of the hub. A plurality of flange bores 60 align with yolk bores 40 allowing fasteners (not shown) to rigidly attach the structures."

a4

At page 4, line 9, please replace the current paragraph with this paragraph:

"FIGURE 3 depicts an isolated view of the hub assembly 20b of the instant invention. The tie bar 26 is attached to the hub assembly 20b via a pair of bearing assemblies 30b attached to the hub yolk 22 by attachment ~~lug~~ lugs 58. The bearing assemblies 30b extend over and contact each respective journal 28. Each bearing assembly ~~30~~30b includes a mated set of opposed, taper conical ~~elastomeric~~ bearing elements, 32 and 34, enclosed within an outer housing 42b. When preloaded in the axial direction, the opposed bearing assembly 30b limits

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the force couple to each individual bearing assembly 30b. According to the invention, the force couple is not passed through the hub center body. 22. The force couple yields a bearing pre-load path 43b that remains entirely within each respective bearing assembly 30b."

At page 4, line 18, please replace the current paragraph with this paragraph:

"FIGURE 4 depicts an exploded view of the ~~flap~~ bearing assembly 30b. The bearing assembly 30b~~. The bearing assembly 30~~ includes an outboard bearing element 34 and an inboard bearing element 32 disposed within an outer housing 42b. The outer housing ~~42~~ 42b includes a first section 45 and a second section 47."

At page 4, line 22, please replace the current paragraph with this paragraph:

"The first section 45 includes a pair of radially extending flange sections 36. The flange sections 36 are configured to align with the hub yolk 38 (FIG. 1). An inner surface of the first section 45 is shaped to receive the second section 47 and, thus, the inboard bearing element 32. More specifically, an outer surface of the ~~inboard~~outboard bearing element ~~32~~34 engages an elastomeric bearing element 54 which, in turn is bonded to ~~the~~a race 61 formed in an inner surface of the outer housing 42b in the first section 45. The bonding method is suitably any commonly known bonding method used in the art."

At page 4, line 28, please replace the current paragraph with this paragraph:

"~~Disposed inside and adjacent the outer surface of the inboard bearing element 32 is an elastomeric element 54.~~ The composition of the elastomeric element 54 can be any of the commonly employed elastomeric compositions, and is variable based upon the loading requirements of the employment environment. For example, an elastomeric element with a plurality of metal laminates is considered within the scope of this invention."

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816 Second Avenue
Seattle, Washington 98104
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At page 4, line 33, please replace the current paragraph with this paragraph:

"Positioned on an inner surface of the ~~elastomeric element 54~~second section 47 is ~~an~~ ~~inner~~ race ~~of the inboard bearing element 62.~~ for receiving the elastomeric element 57 which receives the inboard bearing element 32. The ~~inner~~ race 62 includes a distal section 63 and a proximal section 65. ~~The~~ An outer ~~surface~~edge of the ~~inner~~ race 62 is tapered in the direction of the inner bearing element 32. The inner surface of the proximal section 65 forms an axial bore 44 therethrough. The bore 44 is sized to receive the journal 28 through an open end 55 and extends into the distal section 63. The axial bore 44 terminates at an inner race closed end plate 53 located in the distal section 63. ~~An outer surface of the distal section is substantially cylindrically shaped and configured to receive an inner race of the outboard bearing 64.~~"

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At page 5, line 6, please delete the current paragraph.

At page 5, line 13, please replace the current paragraph with this paragraph:

"~~The outer plate and the inner race closed end plate 63 have~~ The closed end plate 53 has a plurality of aligned bores extending therethrough. A tie bar attachment bore 46 is centrally disposed through each to receive a tie bar attachment lug (not shown). The tie bar attachment lug maintains the bearing ~~assemblies 30~~assembly's 30b connection with the tie bar 26. Further, a plurality of coupler bores ~~48 area~~ (not shown) disposed through the respective surfaces. Each coupler bore receives a coupler lug 49 (FIG. 6) to forcibly join the outer housing 42b and thereby maintain the spatial integrity between the inboard and outboard bearing elements. It will be appreciated that the coupler bores are positioned so as not to interfere with the insertion of the journals into the bearing assemblies 30b. Further, a plurality of dowel bores extend through the ~~respective plates,~~ closed end plate 63, with each bore receiving alignment dowels (not shown) extending from the journal end 29 (FIG. 1)."

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AB cont'd

The bearing elements, 32 and 34, combine within the bearing assembly ~~30~~30b to carry the flap-wise motion of the rotor assembly 24."

At page 6, line 12, please replace the current paragraph with this paragraph:

"FIGURES 7 and 8 depict an isolated view of the opposed conical elastomeric bearing assemblies with and without pre-loading, FIG. 7, and with pre-loading, FIG. 8. A bearing gap 82 is located between the respective inboard and outboard bearing elements, 32 and 34 respectfully, prior to any axial pre-loading. As the axial pre-load is applied the bearing elements, 32 and 34, are brought together. The ~~inner races, 62 and 62, frictionally~~elastomeric bearing elements 54 and 57 engage one another and any space, or bearing gap 82, between the bearing elements, 32 and 34 is removed. The bearing elements, 32 and 34, combine within the bearing assembly 30b to carry the flap-wise motion of the rotor assembly 24 (FIG. 2)."

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At page 5, line 21, please replace the current paragraph with this paragraph:

"FIGURE 5 depicts an assembled view of the ~~flap~~ bearing assembly 30~~.~~b. The inboard bearing element 32 and the outboard bearing element 34 are coupled ~~via a friction fit~~ between the respective elements of the outer housing 42bConsequently, the outer housing 42 encompasses both the inboard bearing element and the outboard bearing in a single unitary assembly."

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NEW MATTER

At page 5, line 29, please replace the current paragraph with this paragraph:

"FIGURE 6 depicts the assembled ~~flap~~ bearing assembly 30. The bearing assembly includes an outer housing 42b surrounding the inner and outer bearing elements 32 and 34 (FIGS. 4 and 5). ~~the bearing coupler lugs 49. More specifically, the inner race of the outboard bearing 64 and the inner race of the inboard bearing 62 are frictionally mated upon insertion of the outboard bearing element 34. Additionally, the outer race of the outboard bearing 66 is bonded to the inner surface of the outer housing 42. Consequently, the outer housing 42 encompasses both the inboard bearing element and the outboard bearing in a single unitary assembly.~~ The outboard bearing assembly 34 is pressure fit into the inboard bearing element 32 and then bonded between the outer race of the outboard baring 66 and an inner surface of the inboard bearing."

a12

At page 6, line 12, please replace the current paragraph with this paragraph:

"FIGURES 7 and 8 depict an isolated view of the opposed conical elastomeric ~~bearings~~bearing assemblies with and without pre-loading, FIG. 7, and with pre-loading, FIG. 8. A bearing gap 82 is located between the respective inboard and outboard bearing elements, 32 and 34 respectfully, prior to any axial pre-loading. As the axial pre-load is applied the bearing elements, 32 and 34, are brought together. The inner races, 62 and ~~64~~62, frictionally engage one another and any space, or bearing gap 82, between the bearing elements, 32 and 34 is removed.

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816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301

In the Claims:

14. (Amended) A rotary aircraft fully articulated hub assembly, comprising:

a hub center body including a plurality of attachment sections, configured to receive a plurality of bearing assemblies, positioned about a periphery of the hub center body;

a plurality of rotor assemblies configured to receive a pair of bearing assemblies; and

a plurality of bearing assemblies, each bearing assembly including an outer housing having an outer surface and an inner surface, the outer surface configured to mechanically connect the bearing assembly to the attachment sections of the hub center body, the inner surface being configured to receive a pair of taper conical elastomeric bearing elements, each bearing element having an inner race and an outer race, an axial pre-load being applied through the inboard bearing element and the outboard bearing element, the respective inner race bearing elements being configured to receive a portion of the rotor assemblies.

BLACK LOWE & GRAHAM PLLC
816 Second Avenue
Seattle, Washington 98104
206.381.3300 • F: 206.381.3301